REMOVING SPOTS AND GRASS BY LINT CLEANING AT COTTON GINS

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REMOVING SPOTS AND GRASS BY LINT CLEANING AT COTTON GINS

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ABSTRACT

Experiments were conducted in 1971 and 1972 to determine the effect of saw-cylinder lint cleaning at gins on improving cotton color and on removing spot and grass from spindle-picked cottons. Increasing the number of lint-cleaning stages produced a consistent and statistically highly significant improvement in the classer's color element of grade. The greatest improvement was obtained between no lint cleaner and one lint cleaner; additional but smaller improvements resulted from each additional stage added. Grade color varied from Low Middling Light Spotted for cotton with no lint cleaning to Middling after three cleaners. The lint cleaners removed some of the grass, stems, and bark from the cotton, although some remained even after three stages of lint cleaning. This implies that field-production practices that prevent the harvesting of such foreign matter with the cotton can best guarantee cotton bales free of grass, stems, and bark.

INTRODUCTION

More than any other single development, the saw-cylinder lint cleaner has made the mechanical harvesting of seed cotton feasible. Lint cleaning provides consistent and significant grade improvements in machine-picked cottons, including increased value. In 1973, over 99 percent of the gin batteries in the United States had at least one stage of lint cleaning, 82 percent had at least two stages, and 19 percent of the batteries had three or more stages of cleaning (*7*).[2]

A sizable percentage of cottons processed at cotton gins are classed as Light Spotted in color, or are reduced in grade because they contain grass. Before recommending procedures for handling such cottons at the gin, it was necessary to show the effect of lint-cleaning machinery on cotton color and grass removal, and previous work on the subjects was limited.

The foreign-matter content of harvested cottons and the price-spread among grades determine the degree of saw-cylinder cleaning required at gins. Too many stages of cleaning could reduce bale value, because the additional weight extracted would offset any gain in grade improvement. Data on White cottons have indicated that, as a general rule, the grower can obtain maximum bale value by using one lint cleaner on early-season clean cottons, and two stages of lint cleaning on late-season, trashier cottons. Lint cleaners also appear to remove some grass from ginned lint (*4*).

In a 1961 study conducted across the Cotton Belt, Looney et al. showed that weight loss from lint cleaning tends to be slightly higher for Light Spotted and Spotted cottons than for comparable grades of White cotton. Sixty-six percent of the bales tested in West Texas were classed in the spotted categories, as compared to 18 percent in the Midsouth and almost none in California (*3*).

Tests on machine-stripped cotton in 1969 and 1971 showed that lint cleaning had a significant effect upon the number of bales reduced in grade because of excessive bark content. One and two stages of lint cleaning substantially reduced the number of barky bales, but the third stage of lint cleaning did not appear to give further improvement (*2*).

Light-Spotted and Spotted grades comprised

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[2]Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

29.7 percent of ginnings in the United States from 1968 to 1972. Ginnings reduced in grade because of bark, grass, and stems averaged 10.3 percent of the upland crop during this period (*8*).

This report presents the results of a study conducted in 1971 and 1972 at the U.S. Cotton Ginning Laboratory, Stoneville, Miss. The first objective of the investigation was to determine the effect of saw-cylinder lint cleaning on the removal of spots and grass from ginned lint. The second objective was to determine the effect of lint cleaning on the color element of grade. The study tested the hypotheses that (1) increasing the number of saw-cylinder lint-cleaning stages decreases the number of bales classed as Light Spotted, and (2) increasing the number of lint-cleaner stages decreases the number of bales reduced in grade because of grass.

EQUIPMENT AND PROCEDURES

The experiments were conducted in the U.S. Cotton Ginning Laboratory's high-capacity commercial-type gin plant. The ginning machinery sequence consisted of tower drier, six-cylinder cleaner, stick machine, tower drier, six-cylinder cleaner, extractor-feeder, gin stand, and saw-cylinder lint cleaner (three stages). The experiment included four models of lint cleaners manufactured by three companies. They were operated according to manufacturer's recommendations for commercial cotton-ginning plants. An electronic moisture meter served as an aid in adjusting the driers to control fiber-moisture content at ginning. Ginning rate was controlled at 3.6 to 4.2 bales per hour per gin stand.

Seed cotton used in the test was grown and machine-harvested by the Delta Branch Experiment Station, Mississippi Agricultural and Forestry Experiment Station, Stoneville, Miss., and by local growers. Harvesting and gin processing were performed on 5 cottons in 1971 (15 bales) and 5 cottons in 1972 (15 bales); a total of 30 one-bale tests were conducted. Cottons were selected from moderate to heavily grass-infested fields, and harvesting covered the period from September 19 to November 8 in both years. Cotton varieties used were 'Stoneville 7A', 'Stoneville 213', and 'Deltapine 16'.

For each experimental cotton there were three replications of one bale each, involving four lint-cleaning treatments—none, one, two, and three stages (fig. 1). Five lint samples were taken from each bale according to a time schedule after each lint-cleaning stage. Samples were obtained for determining (1) seed-cotton moisture and foreign-matter contents before and after seed-cotton cleaning, (2) lint-moisture level at ginning, and (3) lint grade before and after each lint-cleaning stage. The U.S. Department of Agriculture's Agricultural Marketing Service classed the samples at Greenwood, Miss.

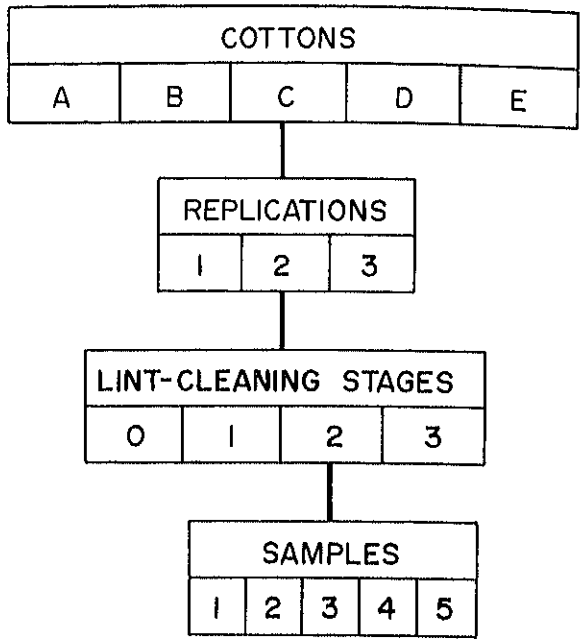

FIGURE 1.—Test layout, 1971 and 1972.

Data from the 2-year study were examined statistically by analysis of variance. Tukey's *w*-procedure was used to indicate significant differences between individual lint-cleaner treatments (*5*).

RESULTS

1971 Crop

Ambient temperature and relative humidity during the experiments ranged from 63° to 80° F and 29 to 69 percent (table 1).

Seed-cotton data.—Samples of seed cotton as delivered had an average moisture content of 12.0 percent. Moisture contents of the cotton, after passage through the seed-cotton drying and cleaning machinery, averaged 9.4 percent (*1*).

Fractionation tests gave an average initial seed-cotton foreign-matter content of 7.0 percent, which was reduced to 2.3 percent by the seed-cotton cleaning system.

TABLE 1.—*Seed-cotton data and lint-moisture contents for five cottons tested in experimental saw-cylinder lint cleanings, 1971*[1]

Cotton	Ambient conditions		Wagon seed cotton (%)		Feeder-apron seed cotton (%)		Lint-moisture[2] (%)
	Temperature (° F)	Relative humidity (%)	Moisture	Trash	Moisture	Trash	
A	74	69	11.4	9.9	8.9	3.1	5.3
B	80	48	11.7	5.5	9.3	2.4	4.8
C	76	64	17.4	6.7	13.8	3.1	6.6
D	65	29	10.5	5.4	8.1	1.1	4.6
E	63	53	8.9	7.5	7.0	1.6	5.1
Average			12.0	7.0	9.4	2.3	5.3

[1]Average of 3 replications for each cotton. Moisture contents determined by ovendrying, ASTM Method D 2495; trash contents determined by fractionation procedure.
[2]Sampled after ginning but before lint cleaning.

Lint-moisture content.—Samples of lint taken after ginning but before lint cleaning indicated moisture levels of 5.3, 4.8, 6.6, 4.6, and 5.1 percent, respectively, for experimental cottons A, B, C, D, and E.

Classer's color grade.—Progressively increasing the number of lint-cleaning stages from zero to three produced a consistent and statistically highly significant improvement in the classer's color element of grade (tables 2 and 3). Grade color index for the samples without lint cleaning averaged 86.8, and those for one, two, and three stages of cleaning averaged 91.7, 93.6, and 94.4, respectively. The improvement in grade color index as a result of employing one lint cleaner as opposed to none was significant at the 1-percent level. The additional improvement for two lint cleaners was not significant, and the further improvement for three cleaners was significant at the 5-percent level.

TABLE 2.—*Classer's grade color designation for five cottons after four amounts of lint cleaning, 1971*[1]

Cotton	Color designation[2] with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A	LM	LM	SLM	SLM
B	LM	SLM	SLM	SLM
C	LM	SLM Lt Sp[3]	SLM Lt Sp[3]	SLM
D	LM	SLM	SLM	SLM
E	SLM	SLM	SLM	M

[1]Datum for each interacting treatment represents the average of 3 replications calculated from the grade indexes of table 3.
[2]The total number of samples classed as Light Spotted for 0, 1, 2, and 3 stages of cleaning were 2, 11, 8, and 5, respectively.
[3]Although Light Spotted in color, these bales were classed in the lower White grades before lint cleaning because of a high foreign-matter content.

After 0, 1, 2, and 3 lint cleanings, 2, 11, 8, and 5 samples, respectively, were classed as Light Spotted in color. Samples with a high foreign-matter content, although Light Spotted in color, are usually classed in the low White grades because these

TABLE 3.—*Cotton grade color indexes for five cottons and three replications after four amounts of saw-cylinder lint cleaning, 1971*[1]

Cotton and replication	Color index with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A:				
1	85.0	85.0	85.0	85.0
2	83.2	86.8	92.2	92.0
3	94.0	94.0	94.0	94.0
B:				
1	88.6	94.0	94.0	94.0
2	85.0	94.0	94.0	95.2
3	86.8	94.0	94.0	94.0
C:				
1	85.8	84.8	91.2	93.0
2	82.2	89.0	91.0	92.0
3	85.0	90.0	90.0	92.0
D:				
1	86.8	90.4	94.0	94.0
2	85.0	94.0	100.0	100.0
3	85.0	94.0	94.0	95.2
D:				
1	88.6	94.0	94.0	96.4
2	94.0	97.6	100.0	100.0
3	86.8	94.0	96.4	98.8
Average[2]	86.8	91.7	93.6	94.4

[1]Grade index for each interacting treatment represents average of 5 samples. Grade index and corresponding grade designation: 100=M, 94=SLM, 85=LM, 76=SGO; 89=SLM Lt Sp, 80=LM Lt Sp.
[2]Differences attributed to number of lint cleanings are significant at the 1-percent level.

grades carry more color. Thus, the increase in the number of samples classed Light Spotted when going from zero to one lint cleaner is attributable to the fact that bales with high foreign-matter content change to a higher grade in the Light Spotted category. Samples varied in classer's color grade from Low Middling with no lint cleaning to Middling after three cleanings.

Grass content.—Lint cleaning decreased the number of bales reduced in grade because of excessive grass, stems, or bark content (tables 4 and 5). The difference between the number of samples not reduced in grade for cotton with no lint cleaning as compared to cotton with one stage of cleaning was significant at the 1-percent level, while differences between one and two stages and between two and three stages of lint cleaning were not significant. Of the 75 samples tested, 69 were reduced in grade when no lint cleaning was used, as compared to only 32 samples reduced after three lint cleaners. Thus, a 54-percent reduction in the number of grades reduced could be attributed to lint cleaning.

Typical samples showing the effect of cleaning machinery on grass content are shown in figure 2. Seed-cotton samples shown were taken from the wagon and at the feeder apron after seed-cotton cleaning; lint samples were collected after zero lint cleaners, one cleaner, two cleaners, and three lint cleaners.

1972 Crop

Ambient temperature and relative humidity during the experiments ranged from 74° to 83° F and 41 to 75 percent (table 6).

Seed cotton data.—Samples of seed cotton before processing had an average moisture content of 11.9 percent. Corresponding moisture contents at the feeder apron averaged 9.5 percent.

TABLE 4.—*Effect of lint cleaning on the number of samples reduced in grade because of grass, stems, or bark after four amounts of saw-cylinder lint cleaning, 1971*[1]

Lint cleaners used	Samples[2]		
	Reduced	Trace	Free
0	69	5	1
1	39	13	23
2	45	5	25
3	32	14	29

[1]Datum for each lint-cleaner treatment represents the results from 5 cottons and 3 replications. Shown are the number of samples reduced by 1 grade because of grass, stems, or bark; those showing traces of these; and those free of these.

[2]75 samples were tested at each lint-cleaning level.

TABLE 5.—*Number of samples reduced in grade because of grass, stems, or bark for five cottons, three replications, and four amounts of saw-cylinder lint cleaning, 1971*[1]

Cotton and replication	Grade reductions with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A:				
1	5	3	3	0
2	4	0	0	0
3	5	0	0	0
B:				
1	5	4	3	2
2	3	1	2	0
3	5	1	2	1
C:				
1	5	0	3	3
2	3	0	3	0
3	4	0	0	0
D:				
1	5	5	5	5
2	5	5	5	4
3	5	5	5	5
E:				
1	5	5	5	5
2	5	5	4	2
3	5	5	5	5
Average[2]	4.6	2.6	3.0	2.1

[1]Datum for each interacting treatment represents the number of samples reduced from the 5 tested.

[2]Differences attributed to number of lint cleanings are significant at the 1-percent level.

Fractionation tests showed an average wagon seed-cotton foreign-matter content of 5.6 percent, which was reduced to 1.5 percent by the seed-cotton cleaners.

Lint-moisture content.—Lint-moisture samples taken after ginning but before lint cleaning had moisture levels averaging 5.9, 6.3, 5.1, 6.4, and 5.7 percent, respectively, for cottons A, B, C, D, and E.

Classer's color grade.—Increasing the number of lint-cleaning stages produced a consistent and statistically highly significant improvement in the classer's color element of grade (tables 7 and 8). Grade color index for the samples without lint cleaning averaged 85.4, and those for one, two, and three stages of cleaning averaged 91.9, 94.9, and 96.7, respectively. The improvement in grade color index achieved as a result of using one lint cleaner rather than none, and that of using two lint cleaners rather than one, were significant at the 1-percent level, but further improvement with three cleaners was not significant.

After 0, 1, 2, and 3 lint cleanings, 30, 12, 10, and

TABLE 6.—*Seed-cotton data and lint-moisture contents for five cottons tested in experimental saw-cylinder lint cleanings, 1972*[1]

Cotton	Ambient conditions		Wagon seed cotton (%)		Feeder-apron seed cotton (%)		Lint-moisture content[2] (%)
	Temperature (° F)	Relative humidity (%)	Moisture	Trash	Moisture	Trash	
A	85	69	11.8	7.5	8.8	1.5	5.9
B	83	75	11.3	4.6	9.5	1.3	6.3
C	74	41	14.1	6.8	10.8	2.0	5.1
D	80	54	13.1	4.5	10.3	1.4	6.4
E	78	47	9.4	4.5	8.1	1.3	5.7
Average			11.9	5.6	9.5	1.5	5.9

[1]Average of 3 replications for each cotton. Moisture contents determined by ovendrying, ASTM Method D 2495; trash contents determined by fractionation procedure.
[2]Sampled after ginning but before lint cleaning.

11 samples, respectively, were classed as Light Spotted in color (table 9). Thus, the greatest improvement was attributed to the first lint cleaner, which reduced by 60 percent the number of Light Spotted samples. Samples varied in classer's color grade from Low Middling Light Spotted with no lint cleaning to Middling after three cleanings.

Grass content.—Samples containing an excessive amount of grass, stems, or bark content can be reduced one or more grades (*6*). Of the 75 samples tested, 17 were reduced in grade or showed traces of grass, stem, or bark when no lint cleaning was used, as compared to only 9, 10, and 7 samples after 1, 2, and 3 lint cleaners (tables 10 and 11), respectively.

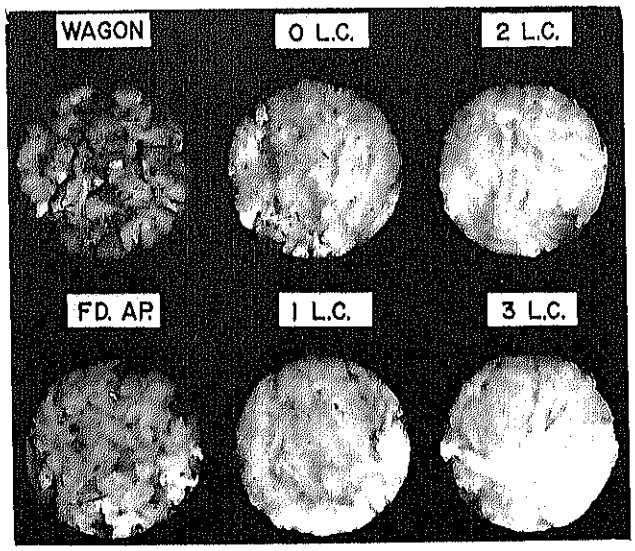

FIGURE 2.—Effect of cleaning machinery on the amount of grass remaining in cotton. Shown are typical seed-cotton grassy samples taken at the wagon and feeder apron, and ginned lint samples after no lint cleaning, and one, two, and three stages of saw-cylinder cleaning.

TABLE 7.—*Classer's grade color designation for five cottons after four amounts of lint cleaning, 1972*[1]

Cotton	Color designation with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A	SLM Lt Sp	SLM	M	M
B	LM	SLM	SLM	M
C	LM Lt Sp	SLM Lt Sp	M Lt Sp	M Lt Sp
D	LM	LM	SLM	SLM
E	LM	SLM	SLM	SLM

[1]Datum for each interacting treatment represents the average of 3 replications calculated from the grade indexes of table 8.

TABLE 8.—*Cotton grade color indexes for five cottons and three replications after four amounts of saw-cylinder lint cleaning, 1972*[1]

Cotton and replication	Color index with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A:				
1	89.0	94.0	96.4	100.0
2	88.2	96.4	100.0	100.0
3	89.0	95.2	95.2	100.0
B:				
1	85.8	92.2	94.0	98.8
2	80.0	94.0	94.0	100.0
3	85.8	94.0	94.0	100.0

TABLE 8.—*Cotton grade color indexes for five cottons and three replications after four amounts of saw-cylinder lint cleaning, 1972*[1]*—Continued*

Cotton and replication	Color index with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
C:				
1	83.0	87.4	92.8	92.6
2	82.0	90.0	96.4	97.6
3	84.6	89.0	97.0	97.6
D:				
1	85.0	86.8	94.0	94.0
2	85.0	85.0	94.0	94.0
3	85.0	92.2	94.0	94.0
E:				
1	88.6	94.0	94.0	94.0
2	85.0	94.0	94.0	94.0
3	85.0	94.0	94.0	94.0
Average[2]	85.4	91.9	94.9	96.7

[1]Grade index for each interacting treatment represents average of 5 samples. Grade index and corresponding grade designation: 100=M, 94=SLM, 85=LM, 76=SGO; 97=M Lt Sp, 89=SLM Lt Sp, 80=LM Lt Sp.

[2]Differences attributed to number of lint cleanings are significant at the 1-percent level.

TABLE 9.—*Number of samples classed with grade color of Light Spotted for five cottons and three replications after four amounts of saw-cylinder lint cleaning, 1972*[1]

Cotton and replication	Light Spotted cotton with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A:				
1	5	0	0	0
2	4	0	0	0
3	5	0	0	0
B:				
1	1	0	0	0
2	5	0	0	0
3	1	0	0	0
C:				
1	2	3	1	3
2	3	4	4	4
3	4	5	5	4
D:				
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
E:				
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
Total	30	12	10	11

[1]Datum for each interacting treatment represents the number of Light Spotted samples for the 5 tested.

TABLE 10.—*Effect of lint cleaning on the number of samples reduced in grade because of grass, stems, or bark after four amounts of saw-cylinder lint cleaning, 1972*[1]

Number of lint cleaners used	Samples		
	Reduced	Trace	Free
0	5	12	58
1	3	6	66
2	7	3	65
3	1	6	68

[1]Datum for each lint-cleaner treatment represents the results from 5 cottons and 3 replications. Shown are the number of samples reduced by one grade because of grass, stems, or bark; those showing traces of these; and those free of these.

[2]75 samples were tested at each lint-cleaning level.

TABLE 11.—*Number of samples reduced in grade because of grass, stems, or bark, and samples showing traces of these, for five cottons, three replications, and four amounts of saw-cylinder lint cleaning, 1972*[1]

Cotton and replication	Grade reductions and traces with—			
	0 lint cleaners	1 lint cleaner	2 lint cleaners	3 lint cleaners
A:				
1	0	0	1	0
2	0	2	0	0
3	0	1	0	0
B:				
1	1	0	1	0
2	0	0	0	0
3	0	0	0	0
C:				
1	5	4	4	5
2	4	0	0	0
3	5	2	3	1
D:				
1	1	0	1	1
2	0	0	0	0
3	0	0	0	0
E:				
1	1	0	0	0
2	0	0	0	0
3	0	0	0	0
Total	17	9	10	7

[1]Datum for each interacting treatment represents the number of samples reduced or showing traces from the 5 tested.

DISCUSSION

The hypothesis that increasing the number of saw-cylinder lint-cleaning stages decreases the number of bales classed as Light Spotted was true in 1971 and was reenforced in 1972 for the increase of from zero to one stage of lint cleaning. Samples

classed as Light Spotted before lint cleaning totaled 32 for the 2-year study, as compared to 23, 18, and 16 after 1, 2, and 3 lint cleaners (table 12). The total decreases in samples classed as Light Spotted after 1, 2, and 3 cleaners were 28, 44, and 50 percent, respectively.

TABLE 12.—*Summary of 1971 and 1972 classer's grade data for four amounts of lint cleaning*[1]

Lint cleaners used	Color index[2]	Light Spotted cotton[3] (samples)	Grassy cotton[4] (samples)
0	86.1	32	91
1	91.8	23	61
2	94.2	18	60
3	95.6	16	53

[1]Data represent information obtained during the 2-year study involving 5 cottons and 3 replications per year. Differences attributed to number of lint cleanings are significant at the 1-percent level for color index and the number of Light Spotted cotton samples, and are not significant for the number of grassy cotton samples.

[2]Averages from tables 3 and 8.

[3]Total tabulated from tables 2 and 9.

[4]Totals from reduced and trace columns, tables 4 and 10.

It was also true that increasing the number of lint-cleaner stages decreases the number of bales reduced in grade because of grass. The greatest decrease in grade reductions was obtained in the first stage of cleaning, an improvement significant at the 1-percent level. Further improvements after two and three lint cleaners were not statistically significant. Samples reduced in grade because of grass, stems, or bark, or that showed traces of these totaled 91, 61, 60 and 53 after 0, 1, 2, and 3 stages of lint cleaning. This represented a 33-, 34-, and 42-percent reduction in grassy samples attributable to the use of 1, 2, and 3 cleaners, respectively.

It is recommended that at least one saw-cylinder lint cleaner be used on ginned lint where a small portion of the cotton being processed is classed Light Spotted or reduced in grade because of grass, stems, or bark. Two stages of lint cleaning should probably be used if a substantial number of bales ginned are classed in these categories.

In some instances three lint cleaners can give increased bale value, particularly on heavy-spotted cottons or those harvested from grassy fields. As a general rule, however, when premiums for grade are small, the additional waste material removed by the third cleaning would cancel the small, if any, grade improvement by reducing the market value of the bale.

Although the lint cleaners effectively improved grade classification, blended out some spots and light spots, and removed some of the grass, stems, and bark from the cotton, even three stages of lint cleaning did not remove all the grass, stems, and bark from all of the cotton. This observation implies that cotton bales free of grass, stems, and bark can be best guaranteed by field-production practices that prevent the harvesting of such foreign matter with the cotton.

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